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(54) **CONTAINER, AND SELECTIVELY FORMED SHELL, AND TOOLING AND ASSOCIATED METHOD FOR PROVIDING SAME**

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(51) **Int. Cl.**

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B21D 22/24	(2006.01)
B21D 51/38	(2006.01)
B21D 37/10	(2006.01)

(52) **U.S. Cl.**

CPC ***B21D 51/44*** (2013.01); ***B21D 22/24*** (2013.01); ***B21D 37/10*** (2013.01); ***B21D 51/26*** (2013.01); ***B21D 51/2653*** (2013.01); ***B21D 51/38*** (2013.01); *Y10T 428/12389* (2015.01)

(58) **Field of Classification Search**

CPC B65D 7/36; B65D 17/08; B21D 51/44; B21D 51/38

See application file for complete search history.

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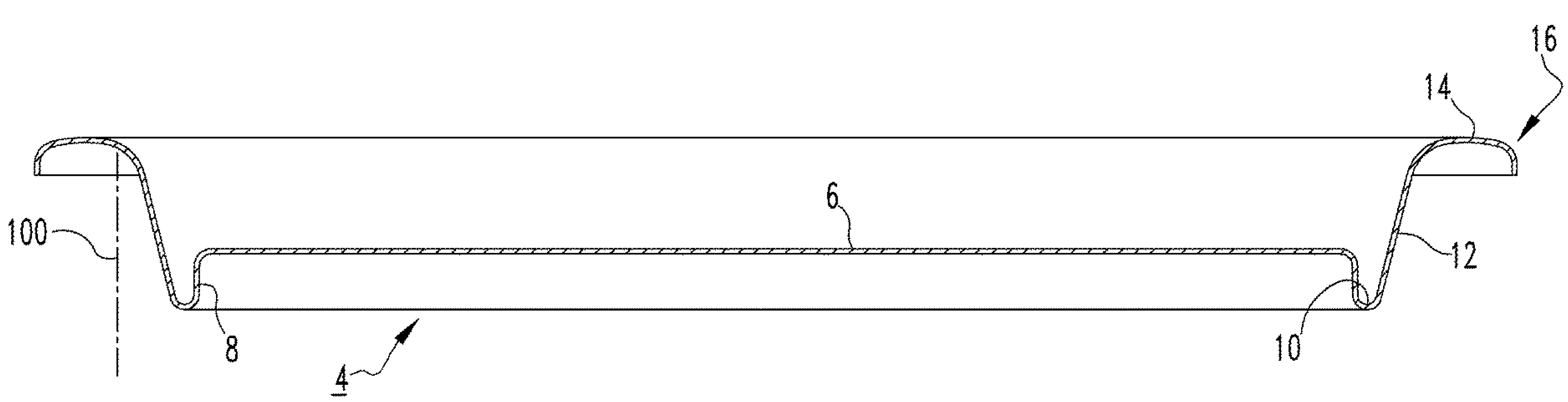
(57) **ABSTRACT**

A shell, a container employing the shell, and tooling and associated methods for forming the shell are provided. The shell includes a center panel, a circumferential chuck wall, an annular countersink between the center panel and the circumferential chuck wall, and a curl extending radially outwardly from the chuck wall. The material of at least one predetermined portion of the shell is selectively stretched relative to at least one other portion of the shell, thereby providing a corresponding thinned portion.

5 Claims, 5 Drawing Sheets



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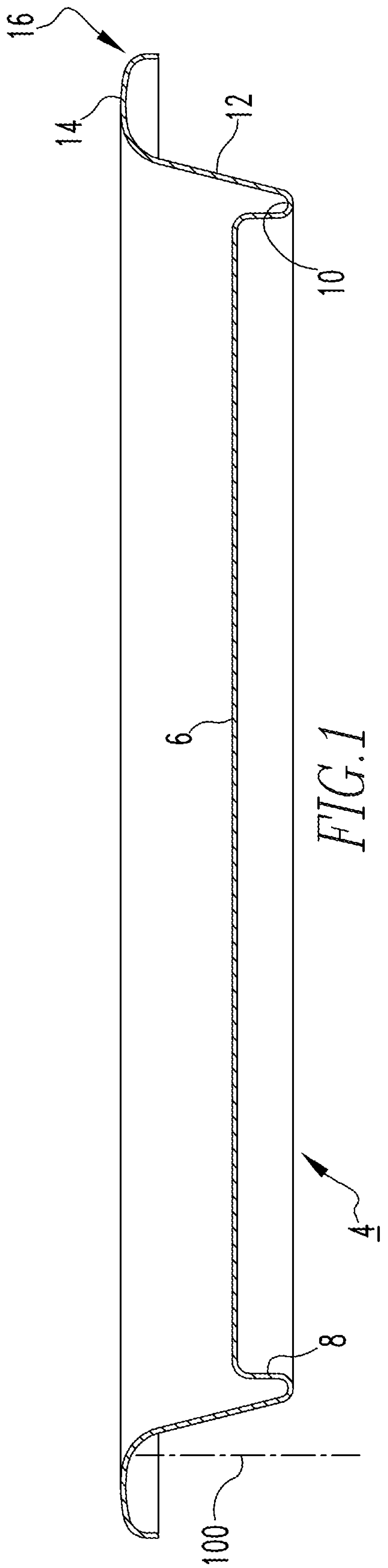


FIG. 1

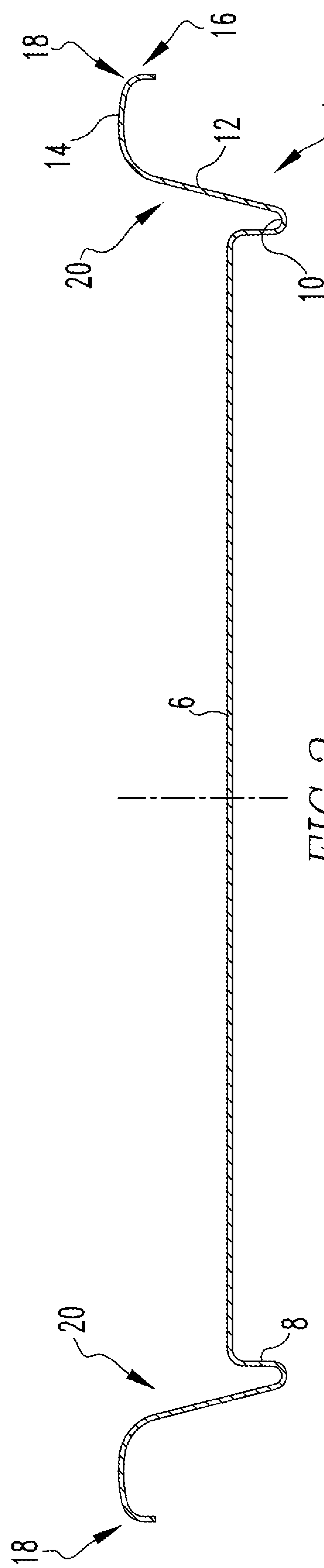
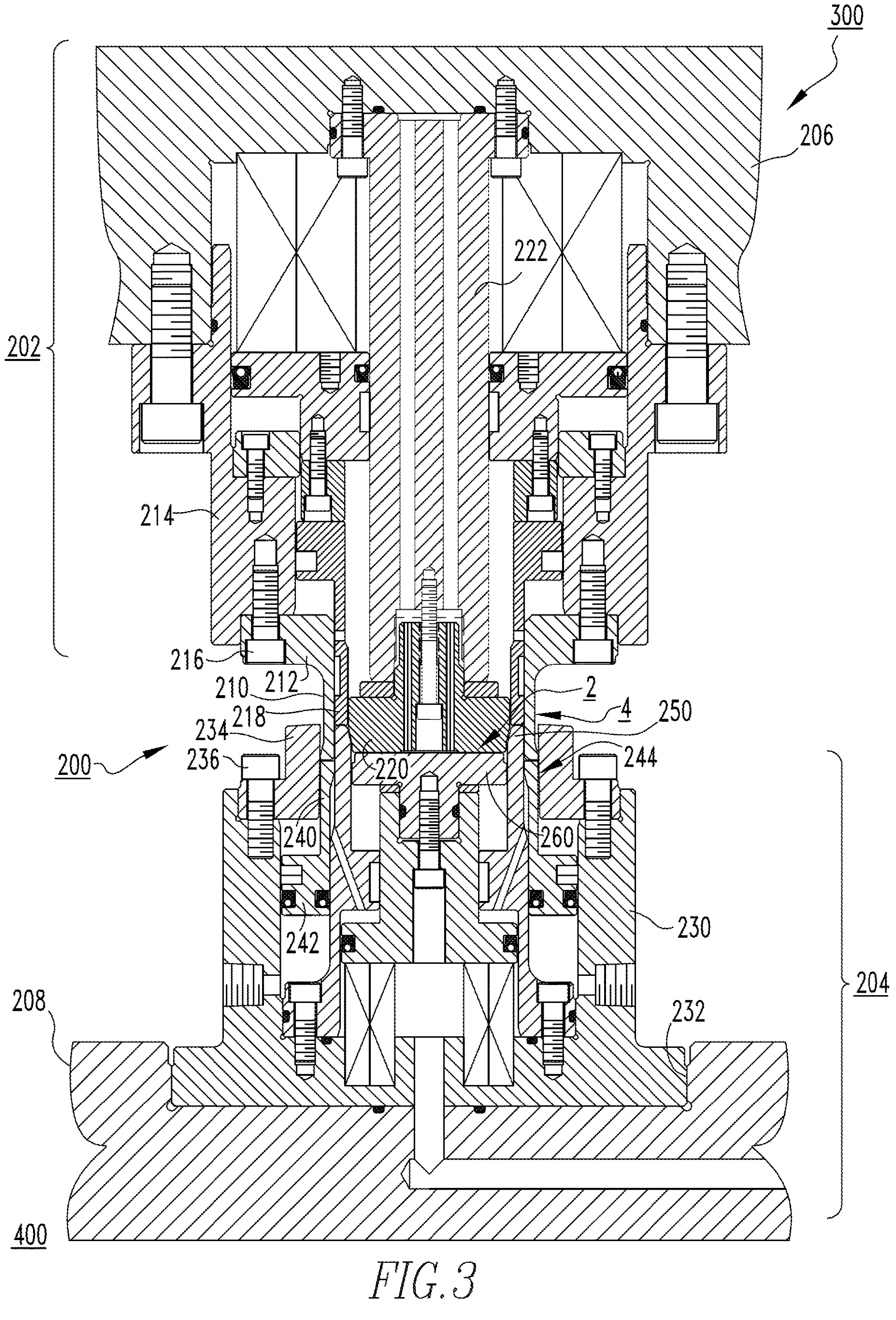


FIG. 2


300
206
222
202
214
216
212
210
218
234
236
200
2
4
250
244
220
240
260
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230
204
208
232
400

FIG. 3

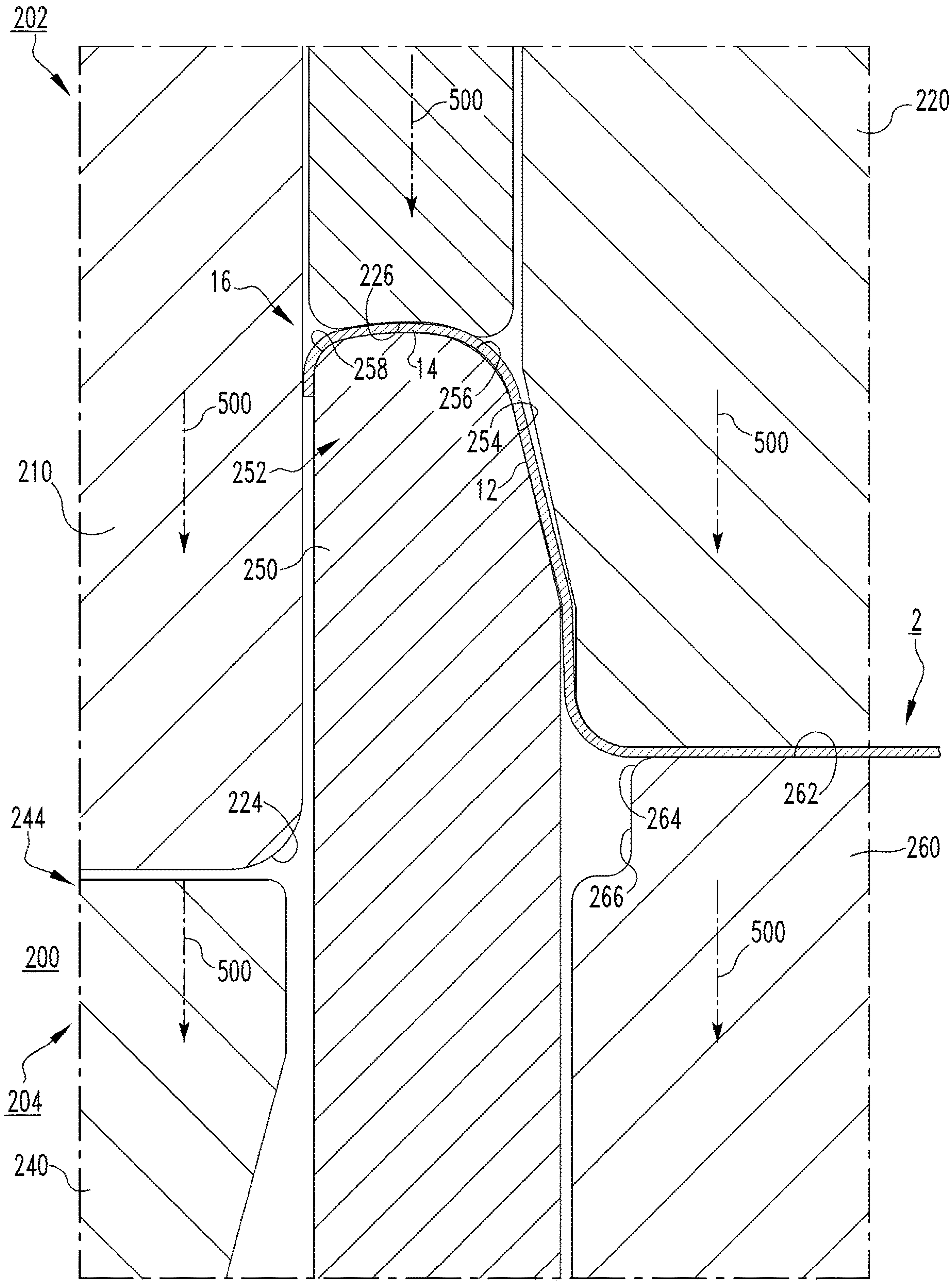
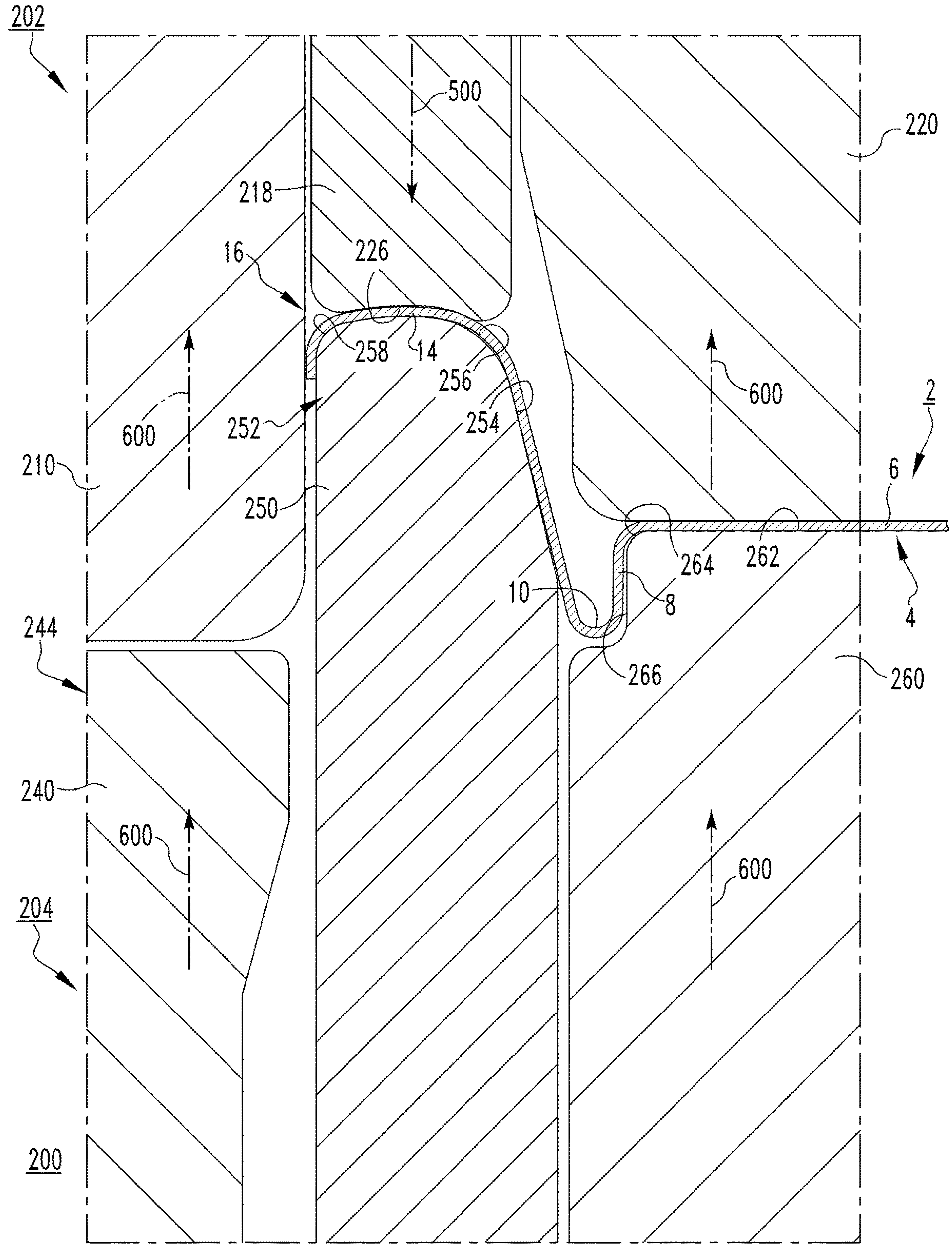

202
500
220
226
16
258
14
256
500
254
500
252
12
210
250
2
224
262
244
264
260
266
500
200
500
204
240

FIG. 4



202
500
220
218
226
16
258
14
256
600
2
254
252
6
600
210
250
264
262
10
8
4
244
266
260
240
600
600
204
200

FIG. 5

FIG.6A

FIG.6B

FIG.6C

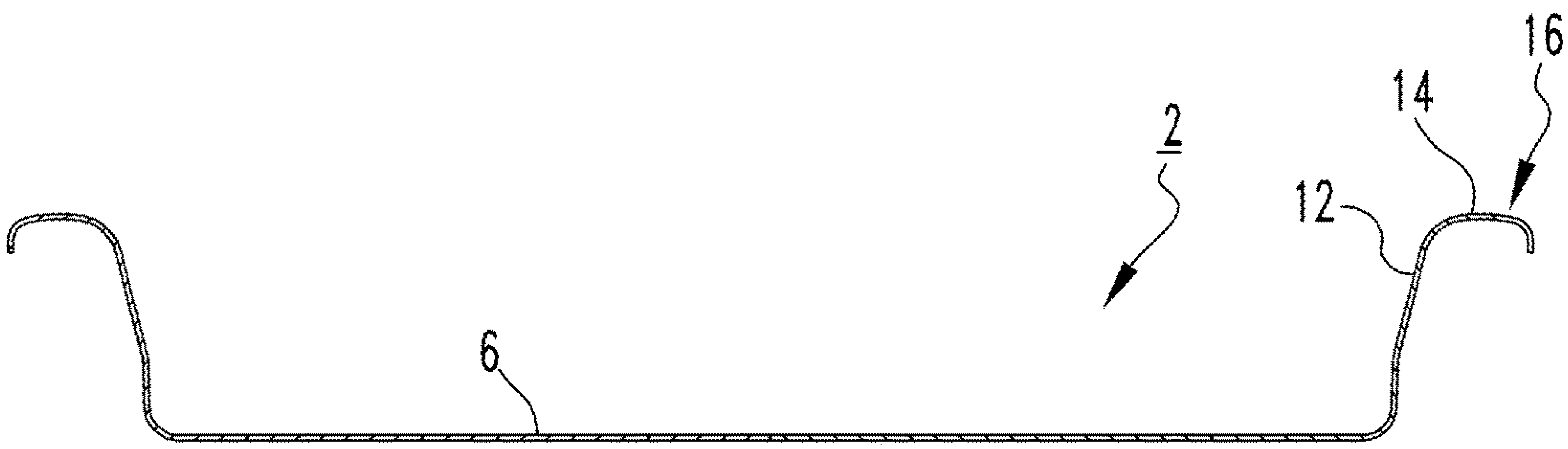


FIG.6D

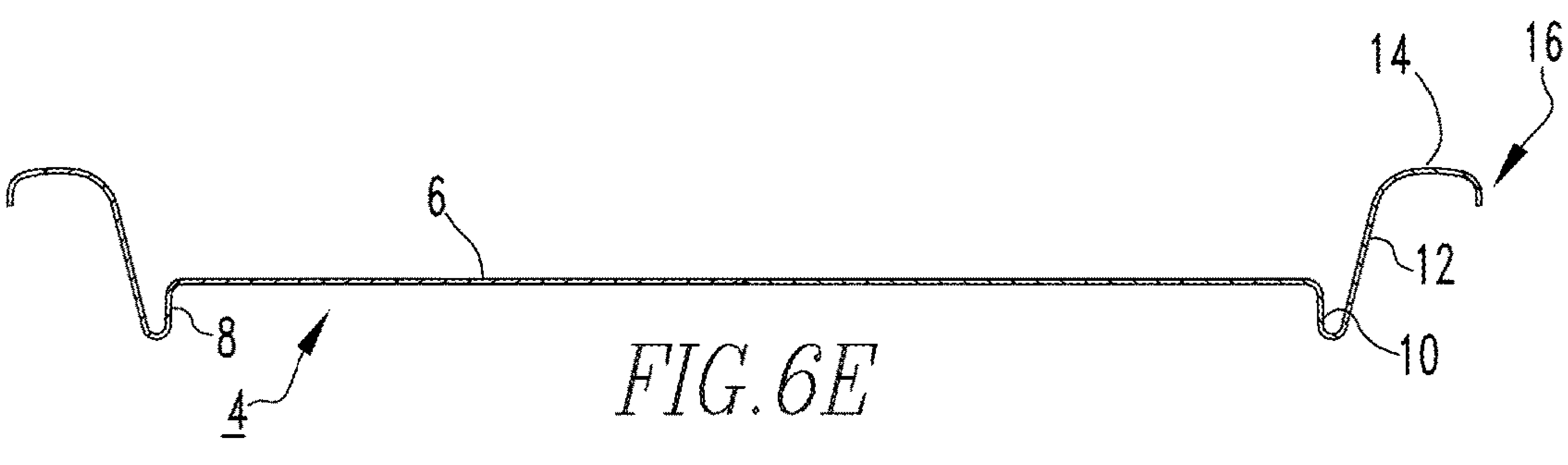


FIG.6E

CONTAINER, AND SELECTIVELY FORMED SHELL, AND TOOLING AND ASSOCIATED METHOD FOR PROVIDING SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation patent application of U.S. patent application Ser. No. 13/894,017, filed May 14, 2013, which application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/648,698, filed May 18, 2012, entitled "CONTAINER, AND SELECTIVELY FORMED SHELL, AND TOOLING AND ASSOCIATED METHOD FOR PROVIDING SAME," which is hereby incorporated by reference as if fully set forth herein. This application further claims priority to U.S. patent application Ser. No. 14/722,187, filed May 27, 2015, entitled "CONTAINER, AND SELECTIVELY FORMED SHELL, AND TOOLING AND ASSOCIATED METHOD FOR PROVIDING SAME."

BACKGROUND

Field

The disclosed concept relates generally to containers and, more particularly, to can ends or shells for metal containers such as, for example, beer or beverage cans, as well as food cans. The disclosed concept also relates to methods and tooling for selectively forming a can end or shell to reduce the amount of material used therein.

Background Information

Metallic containers (e.g., cans) for holding products such as, for example, food and beverages, are typically provided with an easy open can end on which a pull tab is attached (e.g., without limitation, riveted) to a tear strip or severable panel. The severable panel is defined by a scoreline in the exterior surface (e.g., public side) of the can end. The pull tab is structured to be lifted and/or pulled to sever the scoreline and deflect and/or remove the severable panel, thereby creating an opening for dispensing the contents of the can.

When the can end is made, it originates as a can end shell, which is formed from a blank cut (e.g., blanked) from a sheet metal product (e.g., without limitation, sheet aluminum; sheet steel). The shell is then conveyed to a conversion press, which has a number of successive tool stations. As the shell advances from one tool station to the next, conversion operations such as, for example and without limitation, rivet forming, paneling, scoring, embossing, tab securing and tab staking, are performed until the shell is fully converted into the desired can end and is discharged from the press.

In the can making industry, large volumes of metal are required in order to manufacture a considerable number of cans. Thus, an ongoing objective in the industry is to reduce the amount of metal that is consumed. Efforts are constantly being made, therefore, to reduce the thickness or gauge (sometimes referred to as "down-gauging") of the stock material from which can ends and can bodies are made. However, as less material (e.g., thinner gauge) is used, problems arise that require the development of unique solutions. There is, therefore, a continuing desire in the industry to reduce the gauge and thereby reduce the amount of material used to form such containers. However, among other disadvantages associated with the formation of can ends from relatively thin gauge material, is the tendency of the can end to wrinkle, for example, during forming of the shell.

Prior proposals for reducing the volume of metal used reduce the blank size for the can end, but sacrifice the area of the end panel. This undesirably limits the available space, for example, for the scoreline, the severable panel and/or the pull tab.

There is, therefore, room for improvement in containers such as beer/beverage cans and food cans, as well as in selectively formed can ends or shells and tooling and methods for providing such can ends or shells.

SUMMARY

These needs and others are met by the disclosed concept, which is directed to a selectively formed shell, a container employing the selectively formed shell, and tooling and associated methods for making the shell. Among other benefits, the shell is selectively stretched and thinned to reduce the amount of metal required while maintaining the desired strength.

As one aspect of the disclosed concept, a shell is structured to be affixed to a container. The shell comprises: a center panel; a circumferential chuck wall; an annular countersink between the center panel and the circumferential chuck wall; and a curl extending radially outwardly from the chuck wall. The material of at least one predetermined portion of the shell is selectively stretched relative to at least one other portion of the shell, thereby providing a corresponding thinned portion.

The shell may be formed from a blank of material, wherein the blank of material has a base gauge prior to being formed, and wherein, after being formed, the material of the shell at or about the thinned portion has a thickness. The thickness of the material at or about the thinned portion is less than the base gauge. The thinned portion may include the chuck wall.

As another aspect of the disclosed concept, a method is provided for forming a shell. The method comprises: introducing material between tooling, forming the material to include a center panel, a circumferential chuck wall, an annular countersink between the center panel and the circumferential chuck wall, and a curl extending radially outwardly from the chuck wall, and selectively stretching at least one predetermined portion of the shell relative to at least one other portion of the shell to provide a corresponding thinned portion of the shell.

The method may comprise the step of converting the shell into a finished can end. The method may further comprise the step of seaming the finished can end onto a container body.

As a further aspect of the disclosed concept, tooling is provided for forming a shell. The tooling comprises: an upper tool assembly; and a lower tool assembly cooperating with the upper tool assembly to form material disposed therebetween to include a center panel, a circumferential chuck wall, an annular countersink between the center panel and the circumferential chuck wall, and a curl extending radially outwardly from the chuck wall. The upper tool assembly and the lower tool assembly cooperate to selectively stretch the material of at least one predetermined portion of the shell relative to at least one other portion of the shell, thereby providing a corresponding thinned portion.

BRIEF DESCRIPTION OF THE DRAWINGS

A full understanding of the disclosed concept can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

FIG. **1** is a side elevation section view of a shell for a beverage can end, also showing a portion of a beverage can in simplified form in phantom line drawing;

FIG. **2** is a side elevation section view of the shell of FIG. **1**, showing various thinning locations, in accordance with one non-limiting aspect of the disclosed concept;

FIG. **3** is a side elevation section view of tooling in accordance with an embodiment of the disclosed concept;

FIG. **4** is a side elevation section view of a portion of the tooling of FIG. **3**;

FIG. **5** is a side elevation section view of the portion of the tooling of FIG. **4**, modified to show the tooling in a different position, in accordance with a non-limiting example forming method of the disclosed concept; and

FIGS. **6**A-**6**E are side elevation views of consecutive forming stages for forming a shell, in accordance with a non-limiting example embodiment of the disclosed concept.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For purposes of illustration, embodiments of the disclosed concept will be described as applied to shells for a can end known in the industry as a "B64" end, although it will become apparent that they could also be employed to suitably selectively stretch and thin predetermined portions or areas of any known or suitable alternative type (e.g., without limitation, beverage/beer can ends; food can ends) and/or configuration other than B64 ends.

It will be appreciated that the specific elements illustrated in the figures herein and described in the following specification are simply exemplary embodiments of the disclosed concept, which are provided as non-limiting examples solely for the purpose of illustration. Therefore, specific dimensions, orientations and other physical characteristics related to the embodiments disclosed herein are not to be considered limiting on the scope of the disclosed concept.

Directional phrases used herein, such as, for example, left, right, upward, downward, top, bottom, upper, lower and derivatives thereof, relate to the orientation of the elements shown in the drawings and are not limiting upon the claims unless expressly recited therein.

As employed herein, the terms "can" and "container" are used substantially interchangeably to refer to any known or suitable container, which is structured to contain a substance (e.g., without limitation, liquid; food; any other suitable substance), and expressly includes, but is not limited to, beverage cans, such as beer and soda cans, as well as food cans.

As employed herein, the term "can end" refers to the lid or closure that is structured to be coupled to a can, in order to seal the can.

As employed herein, the term "can end shell" is used substantially interchangeably with the term "can end." The "can end shell" or simply the "shell" is the member that is acted upon and is converted by the disclosed tooling to provide the desired can end.

As employed herein, the terms "tooling," "tooling assembly" and "tool assembly" are used substantially interchangeably to refer to any known or suitable tool(s) or component(s) used to form (e.g., without limitation, stretch) shells in accordance with the disclosed concept.

As employed herein, the term "fastener" refers to any suitable connecting or tightening mechanism expressly including, but not limited to, screws, bolts and the combinations of bolts and nuts (e.g., without limitation, lock nuts) and bolts, washers and nuts.

As employed herein, the statement that two or more parts are "coupled" together shall mean that the parts are joined together either directly or joined through one or more intermediate parts.

As employed herein, the term "number" shall mean one or an integer greater than one (i.e., a plurality).

FIGS. **1** and **2** show a can end shell **4** that is selectively formed in accordance with one non-limiting example embodiment of the disclosed concept. Specifically, as described in detail hereinbelow, the material in certain predetermined areas of the shell **4**, has been stretched, thereby thinning it, whereas other areas of the shell **4** preferably maintain the base metal thickness. Although the example shown and described herein refers to a shell (see, for example and without limitation, shell **4** of FIGS. **1**-**3**, **5** and **6**E) for a beverage can **100** (partially shown in simplified form in phantom line drawing in FIG. **1**), it will be appreciate that the disclosed concept could be employed to stretch and thin any known or suitable can end shell type and/or configuration for any known or suitable alternative type of container (e.g., without limitation, food can (not shown)), which is subsequently further formed (e.g., converted) into a finished can end for such a container.

The shell **4** in the non-limiting example shown and described herein includes a circular center panel **6**, which is connected by a substantially cylindrical panel wall **8** to an annular countersink **10**. The example annular countersink **10** has a generally U-shaped cross-sectional profile. A tapered chuck wall **12** connects the countersink **10** to a crown **14**, and a peripheral curl or outer lip **16** extends radially outwardly from the crown **14**, as shown in FIGS. **1**, **2** and **6**E.

In the non-limiting example of FIG. **2**, the shell **4** has a base metal thickness of about 0.0082 inch. This base metal thickness is preferably substantially maintained in areas such as the center panel **6** and outer lip or curl **16**. Keeping the center panel **6** in the base metal thickness helps with rivet, score and tab functions in the converted end (not explicitly shown). For example and without limitation, undesirable issues such as wrinkling and/or undesired score-line and/or rivet or tab failures that can be attributed to reduced strength associated with thinned metal, are substantially eliminated by substantially maintaining the base thickness in the panel **6**. Similarly, substantially maintaining the outer lip **16** at base gauge helps with the seaming ability, for seaming the lid or can end shell **4** to the can body **100** (partially shown in simplified form in phantom line drawing in FIG. **1**). This area where preferably minimal to no thinning occurs, is indicated generally in FIG. **2** by reference **18**.

Accordingly, the majority of the thinning (e.g., without limitation, between 10-20% thinning) preferably occurs in the chuck wall **12**. More specifically, thinning preferably occurs in the area between the crown **14** and the countersink **10**, which is generally indicated as area **20** in FIG. **2**. Thus, by way of illustration, in the non-limiting example of FIG. **2**, the thickness of the material in the chuck wall **12** may be reduced to about 0.0065 inch. It will be appreciated that this is a substantial reduction, which results in significant weight reduction and cost savings over conventional can ends.

It will further be appreciated that the particular shell type and/or configuration and/or dimensions shown in FIG. **2** (and all of the figures provided herein) are provided solely for purposes of illustration and are not limiting on the scope of the disclosed concept. That is, any known or suitable alternative thinning of the base gauge could be implemented in additional and/or alternative areas of the shell (e.g., without limitation, 4) for any known or suitable shell, or end type and/or configuration, without departing from the scope of the disclosed concept.

Moreover, the disclosed concept achieves material thinning and an associated reduction in the overall amount and weight of material, without incurring increased material processing charges associated with the stock material that is supplied to form the end product. For example and without limitation, increased processing (e.g., rolling) of the stock material to reduce the base gauge (i.e., thickness) of the material can undesirably result in a relatively substantial increase in initial cost of the material. The disclosed concept achieves desired thinning and reduction, yet uses stock material having a more conventional and, therefore, less expensive base gauge.

FIGS. **3**-**5** show various tooling **200** for stretching and thinning the shell material, in accordance with one non-limiting example embodiment of the disclosed concept. Specifically, the selective forming (e.g., stretching and thinning) is accomplished by way of precise tooling geometry, placement and interaction. In accordance with one non-limiting embodiment, the process begins by introducing a blank of material (see, for example and without limitation, blank **2** of FIG. **6**A) having a base metal thickness or gauge, between components of a tooling assembly **200**.

FIG. **3** illustrates a single station **300** of a multiple station tooling assembly **200** coupled to a press **400**. For example and without limitation, typically one shell **4** is produced at each station **300** during each stroke of a conventional high-speed single-action or double-action mechanical press **400** to which the multiple station tooling assembly **200** of the disclosed concept is coupled. The tooling assembly **200** includes opposing upper and lower tool assemblies **202**,**204** that cooperate to form (e.g., without limitation, stretch; thin; bend) metal (see, for example and without limitation, metal blank **2** of FIG. **6**A) to achieve the desired shell (see, for example, and without limitation, shell **4** of FIGS. **1**-**3**, **5** and **6**E), in accordance with the disclosed concept.

More specifically, the upper and lower tool assemblies **202**,**204** are coupled to upper and lower die shoes **206**,**208**, which are respectively supported by the press bed and/or bolster plates and the ram within the press **400** in a generally well known manner. An annular blank and draw die **210** includes an upper flange portion **212**, which is coupled to a retainer or riser body **214** by a number of fasteners **216**. The blank and draw die **210** surrounds an upper pressure sleeve **218**. That is, the blank and draw die **210** is proximate to the upper pressure sleeve **218** and is located radially outward from the upper pressure sleeve **218**. An inner die member or die center **220** is supported within the upper pressure sleeve **218** by a die center riser **222**. The blank and draw die **210** includes an inner curved forming surface **224** (FIGS. **4** and **5**). The lower end of the upper pressure sleeve **218** includes a contoured annular forming surface **226** (FIGS. **4** and **5**).

Continuing to refer to FIG. **3**, an annular die retainer **230** is coupled to the lower die shoe **208** within a counterbore **232**. An annular cut edge die **234** is coupled to the die retainer **230** by suitable fasteners **236**. An annular lower pressure sleeve **240** includes a lower piston portion **242** for movement within the die retainer **230**. The lower pressure sleeve **240** further includes an upper end **244** having a substantially flat surface which opposes the lower end of the aforementioned blank and draw die **210**. The cut edge die **234** is located proximate to the lower pressure sleeve **240** and radially outward from the upper end **244** of the lower pressure sleeve **240**, as shown. A die core ring **250** is disposed within the lower pressure sleeve **240**, and includes an upper end **252** that opposes the lower end or forming surface **224** of the upper pressure sleeve **218**, as best shown in FIGS. **4** and **5**. The upper end **252** includes a tapered surface **254**, a rounded inner surface **256** and a rounded outer surface **258** (all shown in FIGS. **4** and **5**). A circular panel punch **260** is disposed within the die core ring **250** opposite the aforementioned die center **220**. The panel punch **260** includes a circular, substantially flat upper surface **262** having a peripheral rounded surface **264**. A peripheral recessed portion **266** extends downwardly from the rounded surface **264**, as best shown in FIGS. **4** and **5**.

Accordingly, the foregoing tools of the upper tool assembly **202** and lower tool assembly **204** cooperate to form and, in particular, stretch and thin predetermined selected areas of, the shell **4**, as will now be described in greater detail with respect to FIGS. **6**A-**6**E, which illustrate the method and associated forming stages for forming the stretched and thinned shell **4**, in accordance with one non-limiting embodiment of the disclosed concept.

FIG. **6**A shows a first forming step wherein a blank **2** is provided using the aforementioned tooling **200** (FIGS. **3**-**5**). More specifically, respective cut edges of the blank and draw die **210** and annular cut edge die **234** cooperate to cut (e.g., blank) the blank **2**, for example, from a web or sheet of material. In a second step, shown in FIG. **6**B, the tooling **200** cooperates to make a first bend, namely bending the peripheral edges of the blank **2** downward, as shown. Next, in the forming step shown in FIG. **6**C, the outer portions of the blank **2** are further formed, as shown. This is achieved by the inner rounded surface **224** of the blank and draw die **210** cooperating with the upper end **252** of the die core ring **250**, and by the forming surface **226** of the upper pressure sleeve **218** cooperating with the upper end **252** of the die core ring **250**.

Stretching and thinning in accordance with the aforementioned non-limiting embodiment of the disclosed concept will be further described and understood with reference to the fourth forming step, illustrated in FIGS. **4** and **6**D. Specifically, FIG. **4** shows the tooling **200** after a down stroke, wherein all of the tools shown have moved downward in the direction of arrows **500** to the positions shown. That is, the blank and draw die **210** and lower pressure sleeve **240** have moved downward in the direction of arrows **500** to further form the outer lip or curl **16**. The upper pressure sleeve **218** has also moved downward in the direction of arrow **500**, such that the forming surface **226** of the upper pressure sleeve **218** cooperates with the upper end **252** of the die core ring **250** to further form the crown **14**, as shown. The die center **220**, which also moves downward in the direction of arrow **500**, stretches the metal of the blank **2** in the area of the chuck wall **12** as the substantially flat surface of the lower end of the die center **220** clamps the material between the die center **220** and the substantially flat upper surface **262** of the panel punch **260**. The die center **220** and panel punch **260** both move downward in the direction of arrows **500** to stretch and thin the metal in the area of the chuck wall **12** as it cooperates with the tapered surface **254** of the die core ring **250**. Thus, in the fourth forming step, the material of the blank **2** is stretched and thinned in the area that will become the chuck wall **12**, but little to no stretching or thinning occurs in the outer lip or curl area **16**, or in the area that will be later formed into the panel **6** (FIGS. **5** and **6**E) or in the lower area that will be later formed into the annular countersink **10** (FIGS. **5** and **6**E). These areas remain substantially at base gauge metal thickness, as previously discussed hereinabove.

In the fifth and final shell forming step, formation of the shell **4** is completed. Specifically, as shown in FIG. **5**, which illustrates the same tooling **200** shown and described hereinabove with respect to the downward stroke of FIG. **4**, some of the tooling **200** has moved upward in FIG. **5** in the direction of arrows **500** to form the panel **6** of the shell **4**. Specifically, the blank and draw die **210**, die center **220**, lower pressure sleeve **240**, and panel punch **260** all move upward in the direction of arrow **500**, whereas the upper pressure sleeve **218** has stopped moving downward in the direction of arrow **500** at this point and is holding pressure on the shell **4**. This results in the further formation of the outer lip or curl **16** over the rounded outer surface **258** of the die core ring **250**, as well as the further formation of the crown **14** between the forming surface **226** of the upper pressure sleeve **218** and the upper end **252** of the die core ring **250**. The desired final form of the chuck wall **12** is provided by interaction of the upper pressure sleeve **218** and surfaces **254** and **256** of the die core ring **250**. The panel **6** is formed by interaction of the substantially flat upper surface **262** of the panel punch **260** with the die center **220** as both of these components move upward in the direction of arrows **600** with the metal of the blank **2** that becomes the panel **6** disposed (e.g., clamped) therebetween. This movement also facilitates the formation of the cylindrical panel wall **8** and countersink **10**. Specifically, as the panel punch **260** moves upward and the upper pressure sleeve **218** moves downward, the annular countersink **10** is formed within the peripheral recessed portion **266** of the panel punch **260**. The cylindrical panel wall **8** is, therefore, formed as the metal cooperates with the peripheral rounded surface **264** of the panel punch **260**.

Accordingly, it will be appreciated that the disclosed concept differs substantially from conventional shell forming methods and tooling, wherein the material of the blank **2** or shell **4** is not specifically stretched or thinned. That is, while the panel **6**, countersink **10** and outer lip or curl **16** portions of the example shell **4** (FIGS. **1**-**3**, **5** and **6**E) are not stretched or are nominally stretched, whereas the area **20** (FIG. **2**) between the countersink **10** and crown **14** is stretched and thinned during the forming process and, in particular in the fourth forming step shown in FIGS. **5** and **6**D.

It will be appreciated that while five forming stages are shown in FIGS. **6**A-**6**E, that any known or suitable alternative number and/or order of forming stages could be performed to suitably selectively stretch and thin material in accordance with the disclosed concept. It will further be appreciated that any known or suitable mechanism for sufficiently securing certain areas of the material to resist movement (e.g., sliding) or flow or thinning of the material while other predetermined areas of the material are stretched and thinned could be employed, without departing from the scope of the disclosed concept. Moreover, alternative, or additional, areas of the shell (e.g., without limitation, 4) other than those which are shown and described herein could be suitably stretched and thinned, and the disclosed concept could be applied to stretch shells that are of a different type and/or configuration altogether (not shown).

Accordingly, it will be appreciated that the disclosed concept provides tooling **200** (FIGS. **3**-**5**) and methods for selectively stretching and thinning predetermined areas (see, for example and without limitation, area **20** of FIG. **2**) of a shell **4** (FIGS. **1**-**3**, **5** and **6**E), thereby providing relatively substantially material and cost savings.

While specific embodiments of the disclosed concept have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the disclosed concept which is to be given the full breadth of the claims appended and any and all equivalents thereof.

What is claimed is:

1. A shell structured to be affixed to a container, the shell comprising:

a center panel,

a circumferential chuck wall,

an annular countersink between the center panel and the circumferential chuck wall, and

a curl extending radially outwardly from the chuck wall and including an outer lip,

wherein the shell is formed from a blank of material having a base gauge prior to being formed,

wherein the material of at least one predetermined portion of the shell is selectively stretched relative to at least one other portion of the shell, thereby providing a corresponding thinned portion,

wherein, after being formed, the material of the shell at or about the thinned portion has a thickness less than the base gauge,

wherein the material of the shell at or about the outer lip has a thickness substantially the same as the base gauge, and

wherein the thinned portion includes the chuck wall.

2. The shell of claim **1** wherein the material of the shell at or about the center panel has a thickness; and wherein the thickness at or about the center panel is substantially the same as the base gauge.

3. The shell of claim **1** wherein the material of the shell at or about the annular countersink has a thickness; and wherein the thickness at or about the annular countersink is substantially the same as the base gauge.

4. The shell of claim **1** further comprising a crown between the chuck wall and the curl.

5. The shell of claim **1** in combination with a container.

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